



Analysis of Students' Difficulties in Solving Math Problems on Exponents

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ARTICLE INFO	ABSTRACT
Published Online: 23 June 2026	Many studies have been conducted to investigate the difficulties and contributing factors in solving mathematics problems involving exponents. The findings from these studies have yielded varying results. Therefore, a qualitative approach is needed to identify these difficulties and contributing factors. The findings of this study indicate that both S1 and S2 encountered obstacles in solving problems involving exponents, particularly those related to graphing functions. The difficulties identified included accurately understanding the problem statement, mastering concepts, and applying the steps to solve the problem. Based on the underlying factors, undergraduate students made errors in interpreting the instruction to “draw a graph,” leading them to regard finding the derivative of a function as the primary step. Graduate students, on the other hand, predominantly experienced procedural difficulties because they only compiled a table of values without proceeding to the graph-drawing stage, and they were unable to explain the differences between the graphs of linear, exponential, and quadratic functions in detail due to limited understanding of terminology and graph characteristics.
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I. INTRODUCTION

Education is of utmost importance in human life (Yuni & Widodo, 2020). Education plays a role in developing human resources in every aspect of knowledge, skills, and attitudes (Kusumaningrum et al., 2024). Education requires students to study various subjects, including mathematics (Desanti et al., 2023).

Education is an effort undertaken to achieve a better education system, based on laws and the national education system (Abdullah, 2022). In this effort, education encompasses various institutional levels, ranging from early childhood education, kindergarten, elementary school, secondary school, to higher education. Many fields of knowledge are taught, such as mathematics (Efferi, 2021).

Mathematics is a fundamental discipline that underpins the development of technology both today and in the future; this is outlined in the Government Regulation on National Education, Chapter 1, No. 22 of 2006 (Manfaat, 2024). Therefore, mathematics plays a crucial role in various scientific disciplines and is a required subject consistently taught at every level of education—whether in elementary school, secondary school, or higher education (Zulmaulida et al., 2021).

Learning difficulties are a specific condition characterized by obstacles in achieving learning objectives, requiring greater effort to overcome them (Silalahi et al., 2023). Learning difficulties can also be defined as a child's inability to complete tasks assigned by teachers. These difficulties are frequently observed in students during the mathematics learning process (Andini & Zakki, 2024).

Learning difficulties represent a failure to achieve learning objectives, characterized by low academic performance—for example, learning outcomes falling below the minimum proficiency criteria (Syifaa et al., 2025). Students with learning difficulties are those who cannot achieve the level of mastery required as a prerequisite for further learning; therefore, they need remedial or enrichment instruction to master the material they have not yet fully grasped. This is explained by Ika Maryani in her book titled **Intervention Models for Learning Difficulties** (Siregar, 2024).

Exponents, or powers, are one of the competencies that 10th-grade high school (SMA) students must master under the 2013 curriculum. This material is closely related to daily life, not only in mathematics but also in other fields (Mulyani et al., 2022). One such application is in the social sciences, specifically in calculating population growth over a specific period. This topic is also considered essential because it is

interconnected with other mathematical concepts, such as logarithms and radical expressions (Nurjanah et al., 2023) . Based on the results of observations and the School-Based Field Practice (PLP) conducted by the researcher, it was found that 10th-grade students at SMK 4 PGRI Kediri experienced difficulties in solving math problems, particularly those involving exponents. These difficulties were related to the obstacles students faced in the process of solving math problems. The observations revealed that some students felt anxious and lacked confidence when solving math problems. Additionally, some students did not fully understand the explanations provided by the teacher. Students also struggled when faced with practice problems that differed in format from the examples given, particularly in identifying given and unknown information, as well as in determining and applying appropriate problem-solving strategies. Therefore, this study aims to examine the difficulties students face in solving math problems on the topic of exponents. The objective of this study is to describe the types of difficulties experienced by 10th-grade students in solving math problems on the topic of exponents.

II. RESEARCH METHOD

The approach used in this study is a qualitative approach. This study will employ qualitative phases (interviews and questionnaires) to delve deeper into the reasons and perceptions behind these difficulties (Kusumastuti et al., 2025) . The data collection techniques in this study include administering a learning style questionnaire, conducting tests, and conducting interviews. The research instruments used in this study were a learning style questionnaire, an exponential mathematics proficiency test, and an interview guide. Each of these instruments was validated by two experts (Wijayanti et al., 2023) .

The data for this study were obtained through a series of data collection activities aimed at providing an in-depth description of the difficulties students experienced in solving math problems on the topic of exponents (Wahyuningsih et al., 2024) . The collected data consists of descriptive qualitative data, including students’ work samples, verbal statements, and observations of students’ learning behaviors during the learning process and while working on problems (July, 2022) .

Based on the results of the written test and interviews, which reinforced these findings regarding exponential material, it was found that students exhibited various forms of difficulty, including inaccuracies in understanding the concept of exponents, errors in applying the properties of exponents, and mistakes in determining the steps to solve problems. These difficulties were evident in students’ unsystematic answers, the inappropriate use of formulas, and a mismatch between the solution steps and the given problems.

Overall, the data analysis indicates that students’ difficulties in solving math problems on exponents are not solely

influenced by conceptual understanding. These findings suggest that students’ understanding is a critical factor in analyzing and addressing difficulties in learning mathematics (Junaedi & Susilo, 2025) .

Table 4.1 Results of the Correction of Students’ Worksheets

No .	Student Name	Question 1	Question 2	Question 3	Total
1.	Wisnu	0	0	0	0
2.	Fais	0	✓	✓	5
3.	Zaul	0	✓	✓	10
4.	Lala	0	✓	✓	10
5.	Khotion	0	0	0	0
6.	Zahra	0	0	✓	5
7.	Laura	0	✓	✓	7

Based on the results of the correction of the students’ worksheets, the research subjects selected were Wisnu and Khotion. The selection of these two students was based on their performance on the questions, which indicated the most significant level of difficulty compared to the other students. Based on these results, Wisnu and Khotion were selected as research subjects because both demonstrated the most prominent level of learning difficulty. This data serves as the basis for further analysis of the nature and contributing factors of the difficulties students experienced in solving problems related to the material under study. The difficulties selected as subjects 1 and 5.

III. RESULTS

This study yielded data on the various forms of difficulties students experienced in solving math problems on the topic of exponents (Gunawan & Fitra, 2021) . The data were obtained through written tests, observations, and in-depth interviews with the two students who demonstrated the most prominent levels of difficulty in solving exponent problems—namely, Wisnu and Khotion—who were subsequently designated as research subjects. Next, the collected data were analyzed to identify the types of difficulties that arose in each question item answered by the students.

The difficulties selected for items 1 and 5 are as follows:

1. Findings on Student S1’s Difficulties

- The written test results showed that Student S1 had difficulty understanding the problem instructions.

Question number 1

Kerjakan soal ini dibawah dengan benar!

SOAL!

Perhatikan ketiga fungsi berikut ini.

$$f(x) = 2x \quad f(x) = 2^x \quad f(x) = x^2$$

1. Gambarlah ketiga grafik fungsi tersebut.

Figure 3.1, Question 1

Answer S1:

Figure 3.2, Answer S1

Main difficulty: S1 does not yet understand that the instruction “draw the graph” means plotting coordinate points and a curve on a Cartesian plane, not calculating derivatives.

- b. The interview results revealed that Student 1 tends to have difficulty.

R: Wisnu, can you explain what you understand about Question 1?

Student 1: “The question is about functions, sir. There are the functions $2x$, 2 to the power of x , and x squared.”

R: So what is being asked in that problem?

S1: “We’re asked to draw the graph, Sir.”

R: Why did you include the derivatives of the functions in your answer?

S1: “I thought that to draw the graph, I had to find the derivative first, Sir.”

T: Do you remember how to graph a function without using derivatives?

S1: “I don’t really remember, Sir. I’m not sure where to start.”

T: Which part do you find the hardest?

S1: Determining the points on the graph, Sir.

R: So where exactly is your main difficulty?

S1: Understanding how to graph the function, Sir.

- c. Based on the triangulation of the written test and the interview conducted with Student 1 regarding the completion of Question 1, it was found that Student 1 had difficulty interpreting the question’s instructions, which required the student to draw the graph of a function. Therefore, it can be concluded that Student 1’s difficulties with Question 1 encompassed conceptual understanding, procedural application, and the interpretation of the question’s instructions.

- a. The written test results show that Student S1 had difficulty explaining the differences between the three function graphs.

Question 2

Kerjakan soal ini dibawah dengan benar!

SOAL!

Perhatikan ketiga fungsi berikut ini.

$$f(x) = 2x \quad f(x) = 2^x \quad f(x) = x^2$$

1. Gambarlah ketiga grafik fungsi tersebut.

2. Apa yang membedakan ketiga grafik tersebut?

Figure 3.3: Question 2

Student S1’s Answer

Figure 3.4: Student S1’s answer

Based on Student S1’s answer to Question 2, the difficulty lies in understanding the question’s requirements; from the written response, Student S1 merely restated the forms of the functions without providing an explanation of the differences in the characteristics of each function’s graph.

- b. The interview results revealed that Student S1 tended to have difficulty explaining the differences between the three function graphs.

R: Wisnu, try to explain what you understood from Question 2.

Student S1: “The question asks us to distinguish between the function graphs, sir.”

R: In your opinion, what does “distinguishing the graphs” mean in that question?

Student 1: “It seems like the graphs are different, but I’m not sure which parts to explain, Sir.”

R: Why did you just rewrite the function formula in your answer?

S1: “I wasn’t sure what else to write, so I just wrote down the function.”

T: Which part did you find the most difficult?

S1: “Explaining the difference, Teacher. I know the formula, but it’s hard to connect it to the graph.”

R: So, what do you think is your main difficulty with this problem?

S1: “Explaining the differences in the graphs, Sir, not the calculations.”

- c. Based on the triangulation of the written test and the interview conducted with Student 1 regarding the completion of question number 2, it was found that Student 1 had difficulty understanding the intent of the question and stated that while they understood the form of the function’s equation, they became confused when asked to describe the differences in the graphs in writing.

- a. The written test results indicate that S1 struggled with the conceptual understanding of the properties and growth rates of the function’s graph.

Problem No. 3

Kerjakan soal ini dibawah dengan benar!

SOAL!

Perhatikan ketiga fungsi berikut ini.

$$f(x) = 2x \quad f(x) = 2^x \quad f(x) = x^2$$

1. Gambarkan ketiga grafik fungsi tersebut.
2. Apa yang membedakan ketiga grafik tersebut?
3. Dari ketiga grafik fungsi tersebut, grafik manakah yang paling cepat meningkatnya?

Figure 3.5, Question 3

Wisnu’s Answer:

Figure 3.6: S1’s answer

Based on Student S1’s answer to Question 3, the difficulty lies in the conceptual understanding of the properties and growth rates of function graphs, particularly in comparing the graphs of exponential functions with those of linear and quadratic functions.

- b. The interview results revealed that S1 tends to have difficulty with the conceptual understanding of the properties and growth rates of function graphs.

R: Wisnu, can you explain what’s being asked in Question 3?

S1: We’re asked to identify the graph that increases the fastest, Sir.

R: Which graphs are being compared in that question?

S1: The graphs of the functions $2x$, 2 to the power of x , and x squared.

R: So how did you determine which graph increases the fastest?

S1: I chose 2 to the power of x , but I’m not entirely sure.

R: Why are you feeling unsure?

S1: Because I don’t really understand what the graph’s growth rate is supposed to look like.

R: In your opinion, what does the growth rate of the graph mean?

S1: I don’t quite understand, Sir. I know the graph is going up, but I don’t know which one is faster.

R: So what’s your main difficulty with this problem?

S1: Understanding the difference in the rate at which the graphs rise, Ma’am.

R: What do you think would help you understand it better?

S1: If it were explained using a table or graph as an example, Sir.

- c. Based on the results of triangulation between the written test and the interview conducted with Student 1 regarding the completion of question number 3, it was found that Student 1 had difficulty understanding the concept of the growth rate of a function’s graph. Student 1 stated that they did not yet have a clear understanding of what it means for a graph to rise rapidly, so they felt uncertain about determining which graph had the greatest growth rate.

2. Findings on the Difficulties of a Student Named S2

- a. The written test results show that S2 has difficulty with the procedural understanding of drawing a complete function graph.

Question 1

Kerjakan soal ini dibawah dengan benar!

SOAL!

Perhatikan ketiga fungsi berikut ini.

$$f(x) = 2x \quad f(x) = 2^x \quad f(x) = x^2$$

1. Gambarkan ketiga grafik fungsi tersebut.

Figure 3.7, Question 1

S2’s answer

x	f(x) = 2x
-1	2(-1) = -2
0	2(0) = 0
1	2(1) = 2
2	2(2) = 4
3	2(3) = 6

Figure 3.8: S2’s answer

Question 1 asked students to plot three function graphs: $f(x) = 2x$, $f(x) = 2^x$, and $f(x) = x^2$. However, based on the written response, S2 only created a value table for one function—the linear function $f(x) = 2x$ —and did not proceed to plot the graph on the Cartesian coordinate plane.

- b. The interview results revealed that S2 had difficulty plotting graphs.

R: Khotion, try to explain what you understand about question number 1.

S2: The question asks us to plot the graphs of several functions, Sir.

R: Which functions’ graphs are requested in that problem?

S2: The graphs of the functions $2x$, 2 to the power of x , and x squared, Sir.

R: Why did you only create a table of values for the function $2x$ in your answer?

S2: I remember how to make the table better, Sir, but I’m confused about how to proceed.

R: Confused about what?

S2: I’m confused about how to plot the graph on the coordinate plane.

T: Then why didn’t you make a table for the other functions?

S2: I ran out of time and wasn’t very confident, Sir.

R: What do you think is your main difficulty with this problem?

S2: Plotting the graph, especially for functions other than $2x$.

R: What would help you understand it better?

S2: If the steps were explained one by one with examples, Sir.

- c. Based on the triangulation of the written test and the interview with S2 regarding the solution to question number 1, it was determined that S2 generally understood the question’s instructions, which asked students to graph several functions. However, S2 was not yet able to fully carry out the steps for graphing functions.

- a. The written test results indicate that S2 has difficulty understanding the concept of differences between function graphs.

Problem No. 2

Kerjakan soal ini dibawah dengan benar!

SOAL!

Perhatikan ketiga fungsi berikut ini.

$$f(x) = 2x \quad f(x) = 2^x \quad f(x) = x^2$$

1. Gambarkan ketiga grafik fungsi tersebut.
2. Apa yang membedakan ketiga grafik tersebut?

Figure 3.9, Question 2

Student S2’s Answer:

2. Perbedaan utama adalah laju perubahan nilai fungsi atau kemiringan

Figure 3.10: S2’s answer

Question 2 asked students to explain the differences between the three function graphs. In his written answer, S2 provided only a general and very brief explanation, stating that the differences in the graphs lie in the rate of change of the function’s values, or the slope.

- b. Based on the results of an interview conducted with S2 regarding the completion of Question 2.

R: Khotion, try to explain what is being asked in Question 2.

S2: I’m asked to explain the differences between the function graphs, Sir.

R: What kind of differences in the graphs are you referring to?

S2: The rate of change in the values, Sir; some are fast and some are slow.

R: Why is your answer still so brief?

S2: I’m not sure how to explain it in more detail, Sir.

R: Which part do you find the most difficult?

S2: Explaining the differences in the graphs, Sir—not calculating them.

R: What would help you understand it better?

S2: If you explain it while looking directly at the graph, Sir.

- c. Based on the triangulation of the written test and the interview with S2 regarding the solution to problem number 2, it was found that S2 generally understood the problem instructions, but was not yet able to explain the differences in detail and systematically.
- a. The written test results indicate that S2 struggled with a conceptual error in determining the domain of a quadratic function.

Question 3

Kerjakan soal ini dibawah dengan benar!

SOAL!

Perhatikan ketiga fungsi berikut ini.

$$f(x) = 2x \quad f(x) = 2^x \quad f(x) = x^2$$

1. Gambarkan ketiga grafik fungsi tersebut.
2. Apa yang membedakan ketiga grafik tersebut?
3. Dari ketiga grafik fungsi tersebut, grafik manakah yang paling cepat meningkatnya?

Figure 3.11 for Question 3

S2’s Answer

3. Grafik fungsi kuadrat (parabola) akan mengalami peningkatan yang paling cepat ~~selanjut~~ seiring bertambahnya nilai x (untuk x positif)

Figure 3.12: S2’s answer

S2 wrote or assumed that the domain (x) of a quadratic function is restricted or has certain conditions, whereas the quadratic function $f(x) = ax^2 + bx + c$ generally has a domain of all real numbers ($\mathbb{R}$).

- b. Based on the results of an interview conducted with S2 regarding the solution to problem number 3.

R: Khotion, please explain how you solved problem number 3.

S2: I read the problem first, then I immediately looked for the domain and range of the quadratic function.

R: Why did you set limits on the value of X ?

S2: Because I thought every function must have conditions, so I was afraid of making a mistake.

R: If there are no square roots or division, are there any values of X that are prohibited?

S2: That means there aren’t any... so all values of X are allowed.

R: Correct. So what should the domain of the quadratic function be?

S2: The domain is all real numbers.

R: Well, where exactly did you go wrong?

S2: My mistake was with the domain; I restricted X when it shouldn’t have been restricted.

R: Okay, that’s correct. What you need to work on is your understanding of quadratic functions

S2: Yes, I understand

- c. Based on the triangulation results from the written test and the interview with S2 regarding the solution to problem number 3 on quadratic functions, it was determined that S2 had difficulty understanding the concept of the domain of a quadratic function.

IV. DISCUSSION

This study employs a qualitative approach using a descriptive method (Subhaktiyasa et al., 2023). The selection of this approach aligns with the research objective, which is to describe in detail the various difficulties students face when solving math problems on the topic of exponents. In addition, this study also aimed to explore the causes of students’ difficulties, whether related to conceptual understanding, problem-solving steps, or accuracy in performing calculations.

Based on the research findings—which include the results of written tests and interviews with students in the first and second semesters—it can be concluded that both groups of students experienced difficulties in solving problems on exponential material, particularly in the context of graphing functions. In general, the difficulties that arose encompassed the interpretation of problems, conceptual understanding, and the application of solution procedures. Student S1 tended to face obstacles in understanding the intent of the problem instructions, leading to an error in the initial step by writing the derivative of the function when they should have plotted the graph by determining coordinate points on the Cartesian plane. Meanwhile, Student S2 exhibited more significant procedural difficulties because they were unable to complete the graph-drawing process in its entirety; specifically, they only compiled a table of values without visualizing it as a graph and failed to fully solve the other functions. Student S2 also struggled to explain the differences between graphs in detail and made conceptual errors in determining the domain of a quadratic function by restricting the value of x without a valid basis. Thus, the research findings indicate that students’ difficulties with exponential material are not solely due to an inability to perform calculations but are more significantly influenced by a weak conceptual understanding of function graphs, inaccuracies in interpreting problem

requirements, and a lack of mastery of systematic steps in presenting graphs and explaining their characteristics. Furthermore, this study shows that, based on the results of written tests and interviews, the factors causing students to experience difficulties in solving math problems on exponential material are primarily related to limited conceptual understanding and procedural difficulties in representing functions graphically.

These results are consistent with a study conducted by Anabila Cahya Shofiya Junaedi and Ganjar Susilo titled “Analysis of Students’ Learning Difficulties in Mathematics on the Topic of Exponents for 10th Grade Students at SMA Negeri 2 Balikpapan” (Junaedi & Susilo, 2025). The results of this study indicate that the difficulties experienced by students are primarily conceptual in nature; specifically, students do not yet fully understand the concept of exponents or powers, have difficulty multiplying numbers with exponents, struggle to grasp the concept of powers, and face challenges in simplifying radical expressions and in simplifying radical expressions within radicals.

This study is relevant to research conducted by Melinda Tangkoro, Jorry Monoarfa, and Marvel G. Maukar in 2024 titled “Analysis of Students’ Difficulties in Solving Exponential Problems.” This study is based on the assumption that solving exponential problems requires adequate reasoning skills and problem-solving strategies. However, in practice, students still experience various difficulties and make mistakes in the problem-solving process. The study aims to describe the types of difficulties students experience in solving exponential problems (Tangkoro et al., 2024). The results of the study indicate that the level of difficulty students face in understanding the concept reached 18.75% and falls into the low category; skill-related difficulties amounted to 9.82%, which is classified as very low; while difficulties in problem-solving reached 43.75% and are categorized as fairly high.

V. CONCLUSION

Based on the analysis of the difficulties students experienced in solving math problems on exponential material, it can be concluded that both S1 and S2 groups faced obstacles in solving problems on exponential material, particularly those related to graphing functions. The difficulties identified include accuracy in understanding the problem content, mastery of concepts, and the application of solution steps. Thus, students’ difficulties with exponential topics are not only influenced by their ability to perform calculations but are primarily caused by a lack of understanding of function graph concepts, inaccuracies in interpreting problem requirements, and a lack of mastery of systematic steps in presenting and explaining function graphs.

Based on the analysis results, it can be concluded that the factors causing students’ difficulties in solving problems on exponential material are primarily due to limited conceptual

understanding and procedural skills in representing functions graphically. Undergraduate students (S1) made errors in interpreting the instruction to “draw a graph.” Student S2 predominantly experienced procedural difficulties because they only compiled a table of values without proceeding to the stage of drawing the graph, and were unable to explain the differences between function graphs. Other contributing factors included low self-confidence, a tendency to rely on memorized formulas without analysis, and time constraints; thus, students’ difficulties were influenced by both internal and situational factors that are interrelated.

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